Title: Sweet Prediction Factory

Brief Overview:

The main focus of this unit is to give students experience making good predictions using a variety of methodology relating to the novel Charlie and the Chocolate Factory by Roald Dahl. Through simulations, students will explore probability, sampling and data analysis.

NCTM Content Standard/National Science Education Standard:

Data Analysis and Probability

Grade/Level:

Grades 4 and 5

Duration/Length:

3 days (50 – 60 minutes each lesson)

Student Outcomes:

Students will be able to:

- Determine the chances of an event happening using the language of probability.
- Make predictions using two methods of random sampling.
- Create and use frequency tables.
- Identify the difference between guesses and estimates or predictions.
- Interpret class data to identify mean, median, mode and other measures of center.

Materials and Resources:

- Dahl, Roald. Charlie and the Chocolate Factory. New York: Puffin Books, 1964. ISBN: 0-14-240388-1
- Teacher Resources 1 – 7.
- Student Resources 1 – 5.
- Round Color Labels (Avery), 5 colors per sheet.
- Post-It® or other sticky notes (small, all the same size).
- Long plastic or cardboard strip to use as probability scale for the floor (caution tape, plastic ribbon, sentence strips, etc.).
- Tape, glue, scissors, markers or crayons, dry erase markers.
- Paper lunch bags (tallest you can find), one per group.

- Small bag of colored candies (M&M'S® or Skittles® or Fruit Loops®), one per group.

Development/Procedures:

Lesson 1 What Are The Chances?

Introduction

- Referring to the book, Charlie and the Chocolate Factory, you will be using the information in Chapters 5 – 12 to decide the likelihood of getting a winning ticket. These chapters use the language of probability.

Pre-assessment

- Ask your students if they've ever wanted to buy something for a chance to win a great prize. Refer to McDonald's, cereal boxes, and TV commercials that are currently running. Ask them if they think they had a good chance to win. Be sure to have students explain their thinking and justify their responses. During this discussion, assess their use of probability vocabulary and their familiarity with the concepts.

Launch

- Review the events in Chapter 5, "The Golden Tickets," in which Willy Wonka sends out the announcement about the golden tickets being hidden in five candy bars. Pay special attention to the second to last paragraph of the chapter:

> "You never know, darling," said Grandma Georgina. "It's your birthday next week. You have as much chance as anybody else."

- Discuss Grandma Georgina's statement. Ask if Charlie really does have as much chance as anybody else of winning? How do you know? Watch for use of probability vocabulary to see what students know, including: impossible, unlikely, possible, likely, certain.

Teacher Facilitation

- Advanced Preparation: Prepare a large probability scale to use on the floor, using Teacher Resource 1 as a model. It should be long enough for five students to stand on at the same time (approximately 8 ft.). Enlarge Teacher Resource 1 to create a student probability scale for each group. Laminate the scales.

- Break the students into small groups and give each group a probability scale (see Teacher Resource 1) and 5 Round Colored Dot Labels (Avery), one of each color.

- Explain that there were five children who found golden tickets in their candy bars. You will go over the information about each of these children below:

Charlie: usually only has the money to buy one candy bar every year on his birthday.

Augustus Gloop: "He eats *so many* candy bars a day that it was almost *impossible* for him *not* to find one." (according to his mother).

Veruca Salt: Has a rich father who bought hundreds of thousands of candy bars and was willing to keep buying them until his daughter got her ticket.

Violet Beauregard: Is a constant gum chewer, stopping only for meals, but switched to candy bars in hopes of finding a golden ticket.

Mike Teavee: We have no information on how many candy bars he bought or ate and students will need to determine that they can not place him on the probability scale without more data.

Student Application:

- Each group has to place the dots on the scale to indicate the likelihood of each child finding a golden ticket. Students write each character's name on one colored dot. Then, as a group, determine where to place the dots on the scale. Your group needs to come to consensus on your answers. When you are done, each group member should sign the back of the scale.

- Place a big probability scale on the floor in the front of your room. For each character, have a representative from each group stand on the scale at the point where they placed their dot. If there are differences, have students explain their reasoning and have the class agree on one place for each character. Do this for each character. Be sure students are using the probability vocabulary.

Reteaching

- Review the probability vocabulary for any students who are not yet comfortable with the terminology and ask them about what events might be impossible, unlikely, possible, likely or certain and how they decided.

Extension

- Using Post-It® notes, place the names of each character on the probability poster (Teacher Resource 2) and discuss the fraction and decimal representations that correspond to the probability vocabulary.

Embedded Assessment

- Each group member signs the back of their probability cards so that you will be able to assess their understanding.

Lesson 2 A New Contest

Pre-assessment

- Students will take part in an informal assessment by discussing the data analysis terms and processes used to find the center of data, or typical data, including median, range, mode and mean.

Launch

- Tell students that you received announcement of a new contest (use transparency in Teacher Resource 3). A colored ticket has been placed in each candy bar manufactured by the Sweet Factory Candy Company. There are six different colored tickets: red, orange, yellow, green, blue and purple. To be a winner you must collect one ticket of each color. You may be tempted to buy hundreds of thousands of candy bars, like Veruca's dad, but keep in mind that each candy bar costs $2.00. Your job is to find out the fewest number of candy bars you have to buy if you are extremely lucky.

Teacher Facilitation

- Advanced Preparation: Draw a class number line plot on the board.

- Tell students to take a piece of paper and make a guess about how many times they'll need to roll a six color cube to get one of each color.

- Tell students that they will be using a 6-sided cube that has been colored with the colors of the possible tickets. The experiment is a simulation of what would happen if they actually bought a lot of candy bars. They are using a six-sided cube for the simulation, because there are six different colors of tickets to find. A template for the cube is included in Student Resource 1 and students can color it and assemble it with tape or glue.

- Have students that they should create a frequency chart to record the throws of their cubes using tally marks. (A sample frequency table is included in Teacher Resource 4.)

- Tell students to throw the cube and record results using tally marks, until they have at least one of each color.

- After students place their results on the class line plot, find the mean, median, mode and range of the class data.

Student Application

- Conduct the experiment individually, creating cube and frequency table to record data. When students have rolled one of each color, they should stop and count the total number of tosses.

- Using Post-It® notes and a class line plot, plot the total number of candy bars that they would need to buy,

- As a class, identify the mean, median, mode, and range.

Embedded Assessment

- Students will demonstrate ability to create a frequency chart and to display data on a number line plot. Through discussion you can assess their understanding of data analysis terminology.

Re-teaching

- Review how to create frequency charts and calculate mean, median, mode and range.

Extension

- Students calculate how much money they will spend on candy bars until they have one ticket of each color.

Lesson 3 Candy Sampling

Pre-Assessment

- Show transparency of jar of jelly beans (Teacher Resource 5).
- Ask students: If you have a big jar of jellybeans, how can you make a good estimate of the number of jellybeans in the jar? Lead a discussion and see if students suggest sampling.

Launch

- Chocolate is made from cocoa beans. A new shipment of beans just arrived at the factory but the bag ripped open and the beans spilled out. They were almost finished mixing a batch of chocolate and they need just 425 more beans. If they get all the beans that spilled, will they have enough to finish the batch? The good news is, the beans spilled out on the floor of a small room. What should they do?

Teacher Facilitation

Part 1

- Hand out the Cocoa Beans (Student Resource 2). Have students make a prediction about how many beans are there. They can discuss strategies for making a good prediction first. (You can use Teacher Resource 6 for your own information. It shows the cocoa beans on a one-inch grid and gives the total number of beans.)

- Have the students cut out a 1-inch square from a piece of plain paper. (Note: If you have clear plastic 1-inch squares these work very well for this project.)

- Have students drop the 1-inch square randomly on the page of cocoa beans and trace a line around the square. Then have them count the number of cocoa beans inside the square. Partial beans can be combined to count as whole beans. Have them do this a total of five times and record data on worksheet (Student Resource 3).

- After they complete the worksheet lead a class discussion about the results and this method of random sampling.

Part 2

- Our factory is now planning production for next year's batch of "Sweet Colors" a candy-coated small round confection. (Note: You can use M&M'S® or Skittles® or Fruit Loops® or any other candy/cereal that comes in mixed colors. Make sure the bags contain different amounts of each color if you are mixing your own bags.) The problem is that we've lost all our data from last year and we need to order color dyes. We don't know how much to buy. We've decided to sample last year's batch and from there predict how much we need for this year. To do this you will have your students conduct a sampling experiment and gather data. (Teacher Resource 7 lists the percent of each color found in bags of M&M'S® and Skittles®.)

- Students will be working in groups. Distribute a paper lunch bag and a small bag of candy to each group. Also distribute the worksheet (Student Resource 4). Following directions on the worksheet, students will make a guess and then compare it to the actual results.

- Note: For whatever product you are using, determine the number of colors in the bag. You can add more columns to the worksheet if you need them by dividing each column in half before copying. When giving students instructions for how many candies to "grab" use a number that is four (4) more than the total number of colors possible. For example, if your bags have 6 colors, have students grab 10 candies in each grab.

Student Application

- Say: You will be taking four samples of data for this experiment. Without looking in the bag, pick pieces of candy and take them out. Tell students the number of pieces of candy to grab for each sample. Record the color data on the table on the worksheet. Then put them back in the bag, shake the bag gently, and repeat the process three more times.

- Total the number of each color found in the samples. From this information, predict how many there actually are of each color. After recording your predictions, take out all the candies and count the colors to determine and record the actual number.

- Optional Activity: Graph the results on a pie chart or circle graph using paper or a computer program.

Embedded Assessment

- Conducting activities correctly and making close predictions about the actual colors and the number of cocoa beans.

Reteaching

- Review the process of random sampling and projecting results for a larger sample.

Extension

- Have students take the results of 24 samples and turn them into fractions. For example, if they picked 12 blues out of 24 samples their fraction would be 12/24 or 1/2. Have students convert that to a percent, and they'd get 50%. Students will use that percent to predict how many blues are in the total bag. If there were 60 candies in a bag, the prediction would be 50% or 30 blues.

Summative Assessment:

- Use Student Resource 5 to assess student understanding of the objectives. See Teacher Resource 8 for the answer key.

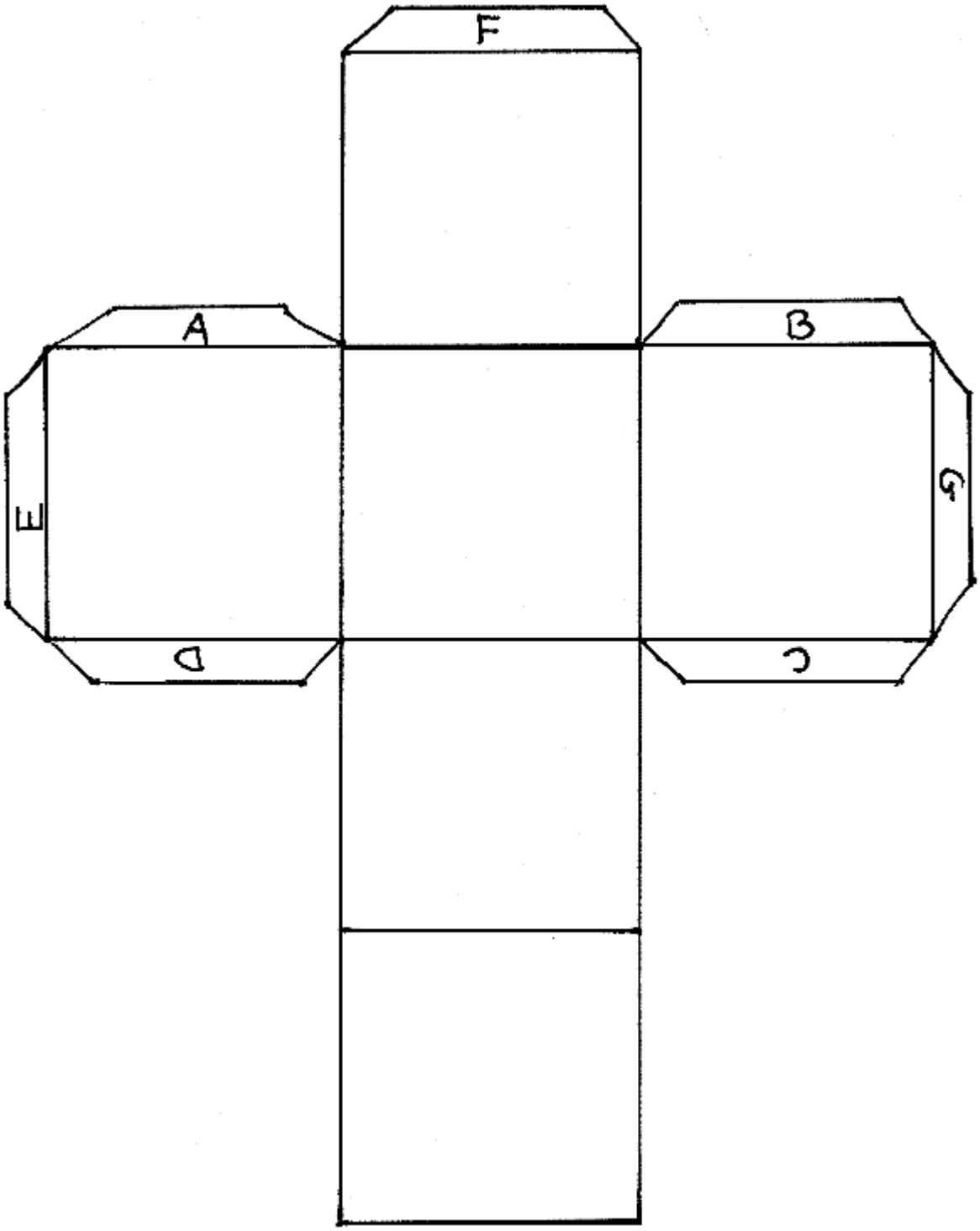
Authors:

Joan McCartan
Hillcrest Elementary
Baltimore County, MD

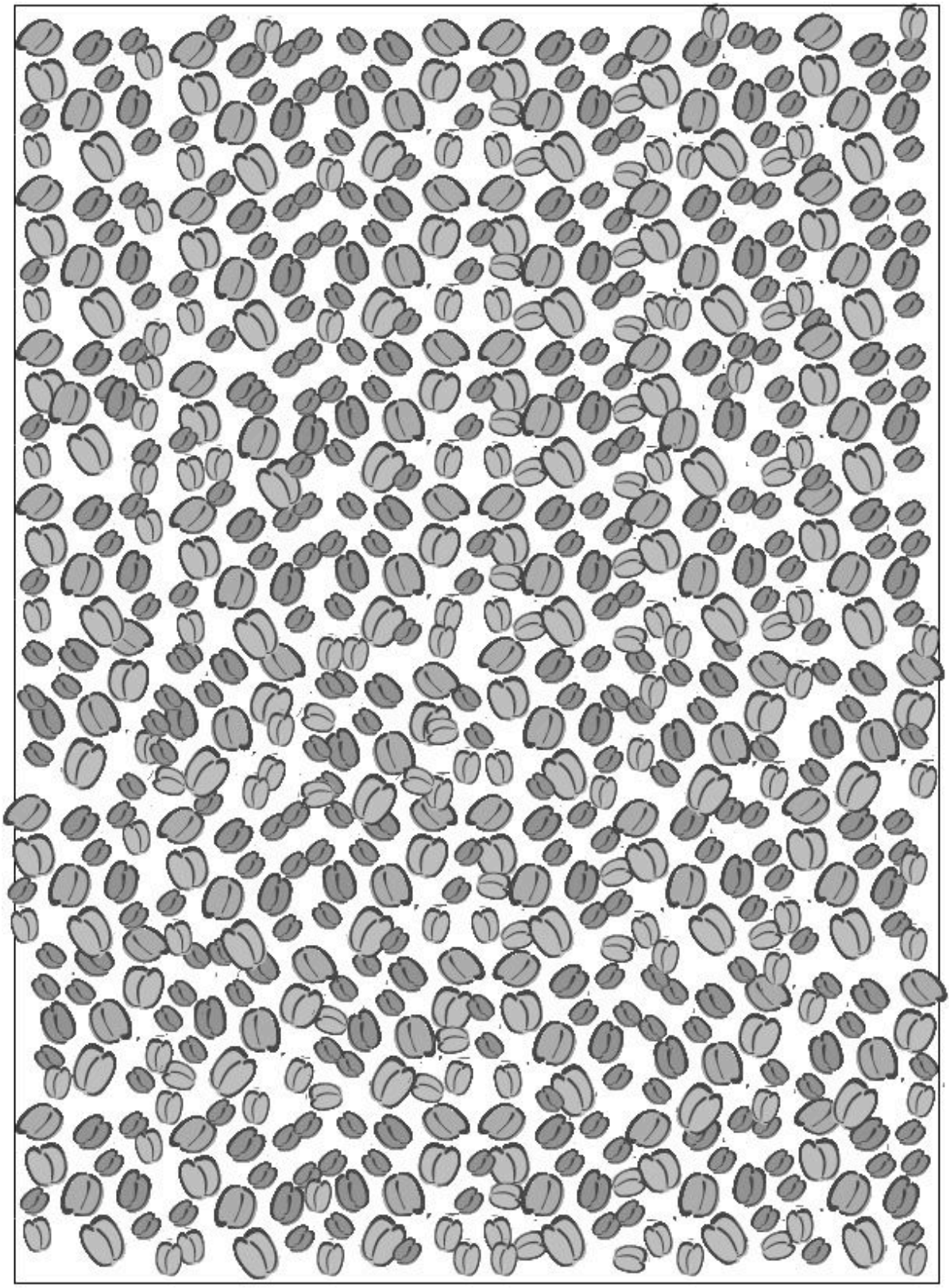
Robin Lempert
Hebrew Day Institute
Silver Spring, MD

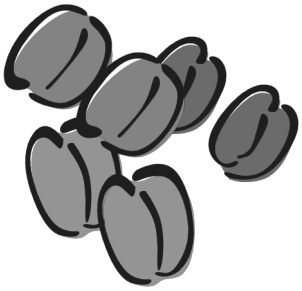
Cube Net

Color each square a different color, using: red, orange, yellow, green, blue, purple. Then cut out the pattern, fold the lettered tabs, and create your cube using tape or glue.



Cocoa Bean Spill





Cocoa Bean Spill

1. Prediction _____

2. Population* Samples
   - A _____
   - B _____
   - C _____
   - D _____
   - E _____

3. Sample Total _____

4. Average (÷ 5) _____

5. Multiply by the number of square units _____

6. Population estimate _____

7. Actual population _____

8. Difference _____

*For this activity, the word "population" means the number of beans in the sample you are counting.

Candy Sampling

Our factory is now planning production for next year's batch of "Sweet Colors", a candy-coated small round confection. The problem is that we've lost all our data from last year and we need to order color dyes. We don't know how much to buy. There are too many candies to sort and count them all. We've decided to sample last year's batch and from there predict how much we need for this year. To do this you will have to sample a bag of candy, record your data, and predict how many of each color are in the bag.

Our Guess:

There will be more _____ candies than any other color.
There will be fewer _____ candies than any other color.

Open your bag of candy and pour it into the paper lunch bag without looking closely at the candies. Without looking in the lunch bag, take turns grabbing a handful of candy. Your teacher will tell you how many pieces to grab. Look at your sample and record your results in the table below. Then put the candies back in the bag, shake gently, and grab another sample.

Possible Colors: _____ _____ _____ _____ _____ _____

First Sample						
Second Sample						
Third Sample						
Fourth Sample						
TOTALS IN ALL SAMPLES						

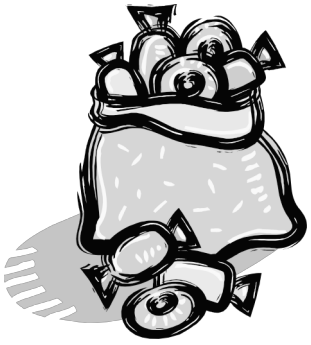
From your data, predict how many of each color there actually are in the bag. After you've recorded your predictions, empty the bag and count and record the actual numbers.

Possible Colors: _____ _____ _____ _____ _____ _____

Our Prediction						
Actual Numbers						

Sweet Prediction Factory

Summative Assessment



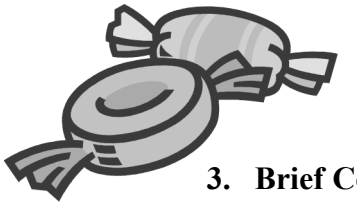
After visiting the Sweet Factory Candy Company, Charlie was given a bag of mixed candy. He reached into his bag fifty times and each time he pulled out one piece of candy. Below is the frequency table that shows his results.

CANDY IN BAG	TALLY MARKS	TOTAL
gum drop	𝍸 ||	
lollipop	|||	
bubble gum	𝍸 𝍸 𝍸 |	
licorice	𝍸 |	
candy bar		13
taffy		4

1. **Complete the frequency table.**

2. **Choose the <u>best</u> answer, based on the frequency table:**

   On his next pick, it is most unlikely that Charlie will get:
   a. a candy bar
   b. a lollipop
   c. bubble gum
   d. licorice



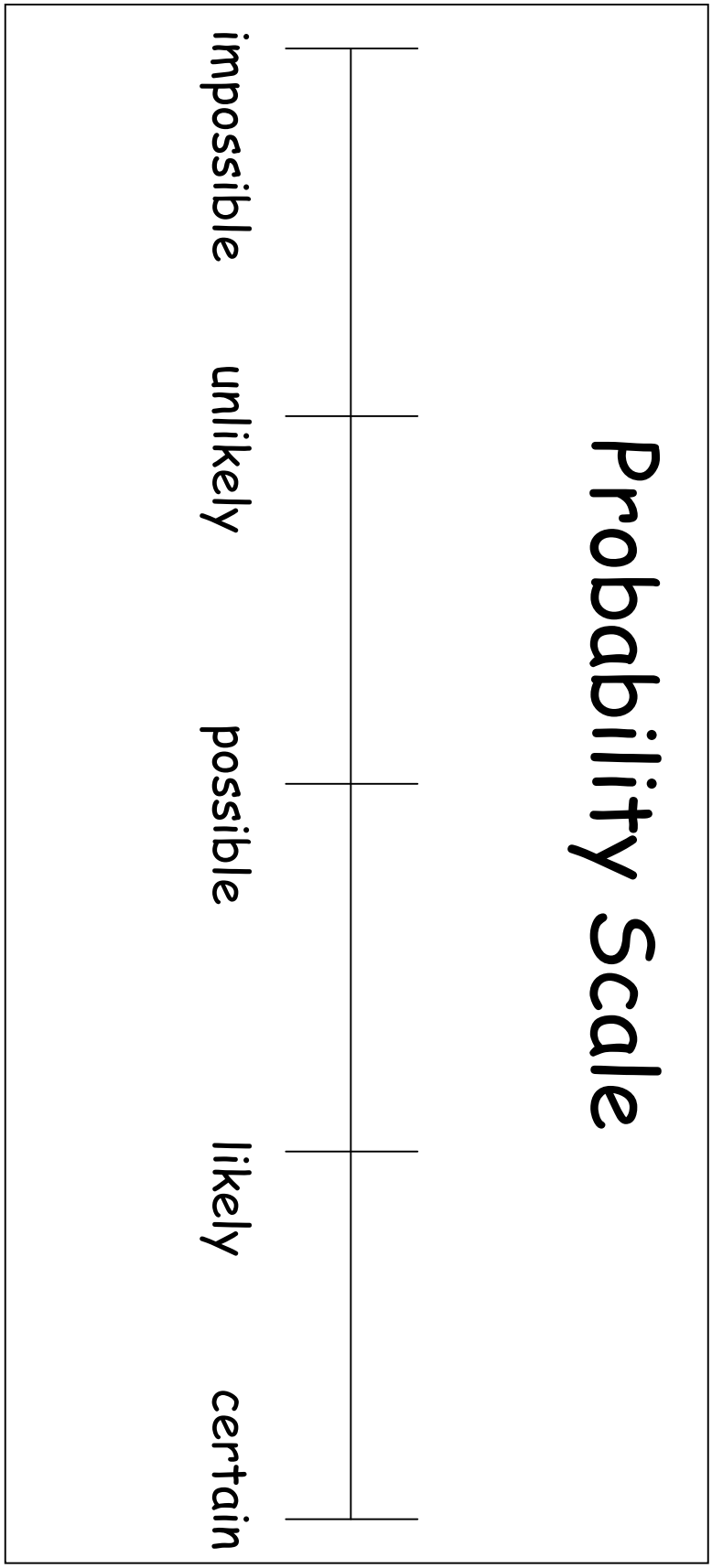
3. Brief Constructed Response

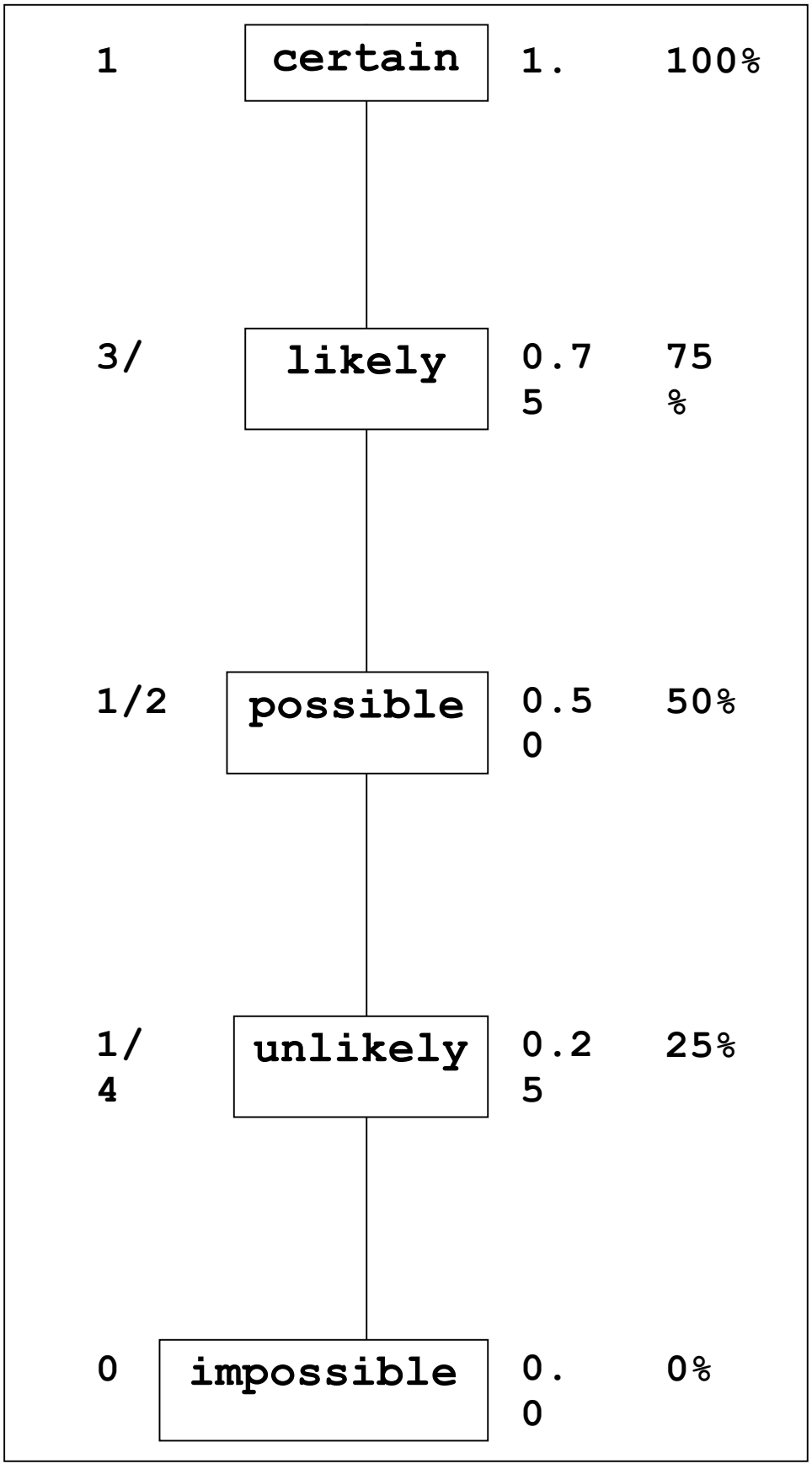
Part A I predict that Charlie will get _____ type of candy on his next pick from the bag of candy.

Part B Use what you know about probability and making good predictions to explain why your answer is correct. Be sure to give examples and use good probability vocabulary to explain the difference between a guess and a prediction.

Explain how the data would change if the Sweet Factory Candy Company added twenty-five pieces of caramel candy to the bag.

Teacher Resource 1



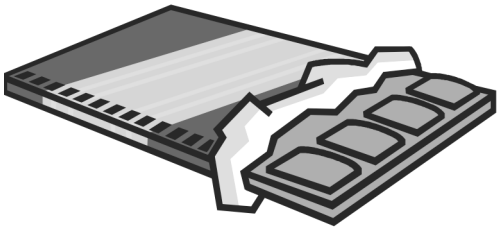

1
certain
1.
100%
3/
likely
0.75
75%
1/2
possible
0.50
50%
1/4
unlikely
0.25
25%
0
impossible
0.0
0%

Important Bulletin

The Sweet Factory Candy Company

(makers of the BEST candy in the whole wide world)

will be holding a contest!



You will find a colored ticket in each of our new delicious Zany Zig Zag Candy Bars.

To be the winner, you must collect one ticket of each color:

Red
Orange
Yellow
Green
Blue
Purple

So hurry, hurry, hurry to buy your
Zany Zig Zag Candy Bar today
and be a winner!

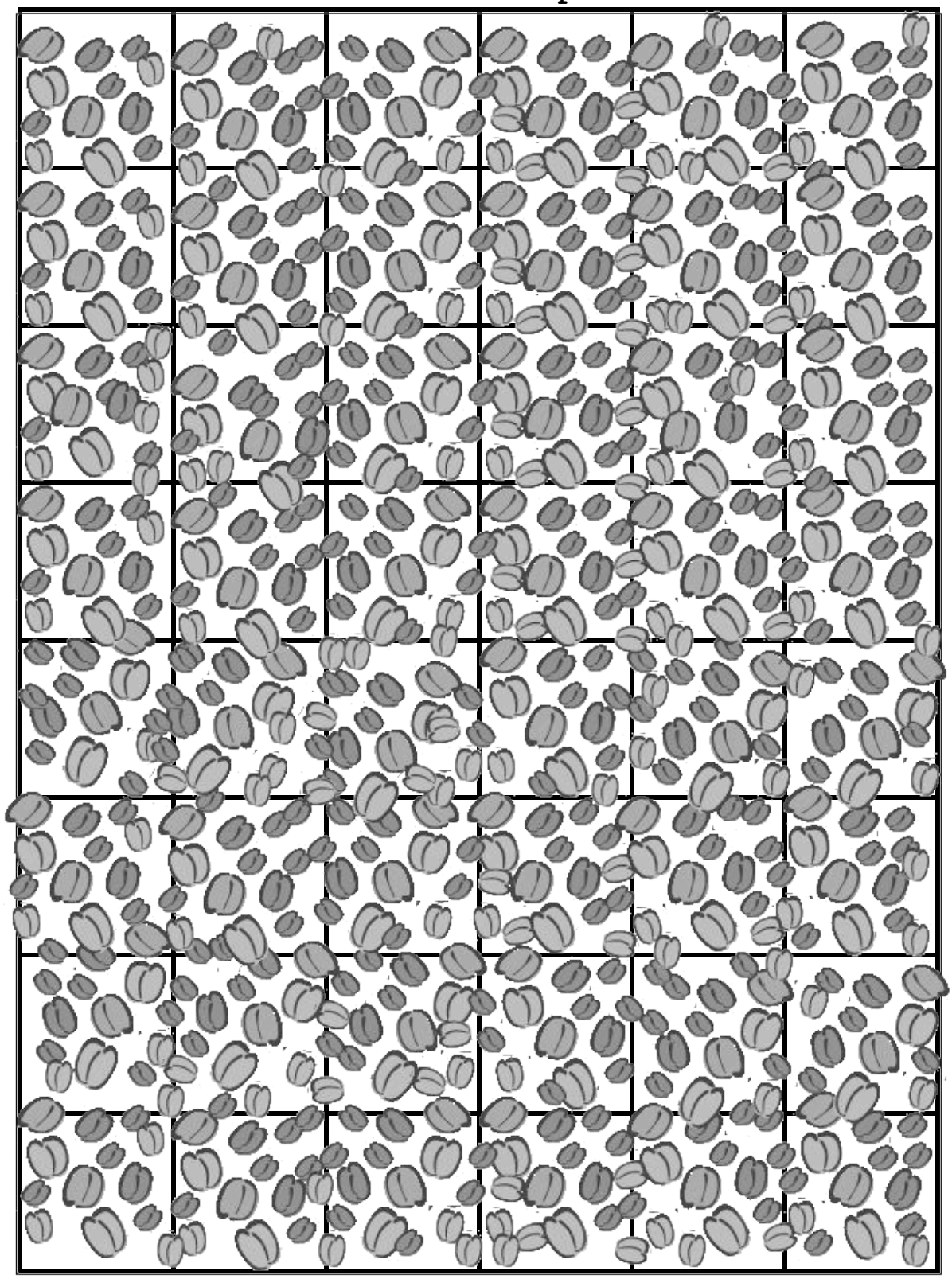
Sample Frequency Table

COLORS	TALLY MARKS	TOTAL
red	𝍸	3
orange	𝍸	2
yellow	𝍸	4
green	𝍸	5
blue	𝍸 𝍸	7
purple	𝍸	5

Teacher Resource 5
Transparency

How Many Jelly Beans?

Cocoa Bean Spill



The cocoa beans fit in a 6 x 8 grid. There are 734 cocoa beans in this picture.

Color Distribution in M&M'S® and Skittles®

In a typical bag of M&M'S®, you will find the following distribution of colors, according to the manufacturer:

Brown	13%
Yellow	14%
Red	13%
Blue	24%
Orange	20%
Green	16%

In a typical bag of Skittles® (original flavors), you will find the following distribution of colors, according to the manufacturer:

Red (Strawberry)	20%
Purple (Grape)	30%
Green (Lime)	20%
Yellow (Lemon)	20%
Orange (Orange)	10%